Nuclear transformation :-

A nuclear reaction in which nucleus of element which is unstable loses energy by radiation and transform into other element is called nuclear transformation.

It may also called nuclear reaction, Radioactive reaction or radioactivity.

This transformation occurs in three com types of decays, which are 1) alpha decay
2) Beta decay
3) gamma decay

It is a random process at the level of single atoms

Radioactivity:

Discovered by Henry Becquerel in 1896. The phenomenon of spontaneous emission of certain kinds of invisible and penetrating rays (radiations) is called as radioactivity and the elements and their salts emitting such type of radiations are called radioactive substances. The invisible and penetrating rays are called radioactive rays or becquerrl rays.

Nature of Radioactive Rays:

Rutherford (1899) and Villard has proved that the radioactive rays are of three types:

(1) α -rays (2) β -rays (3) γ -rays

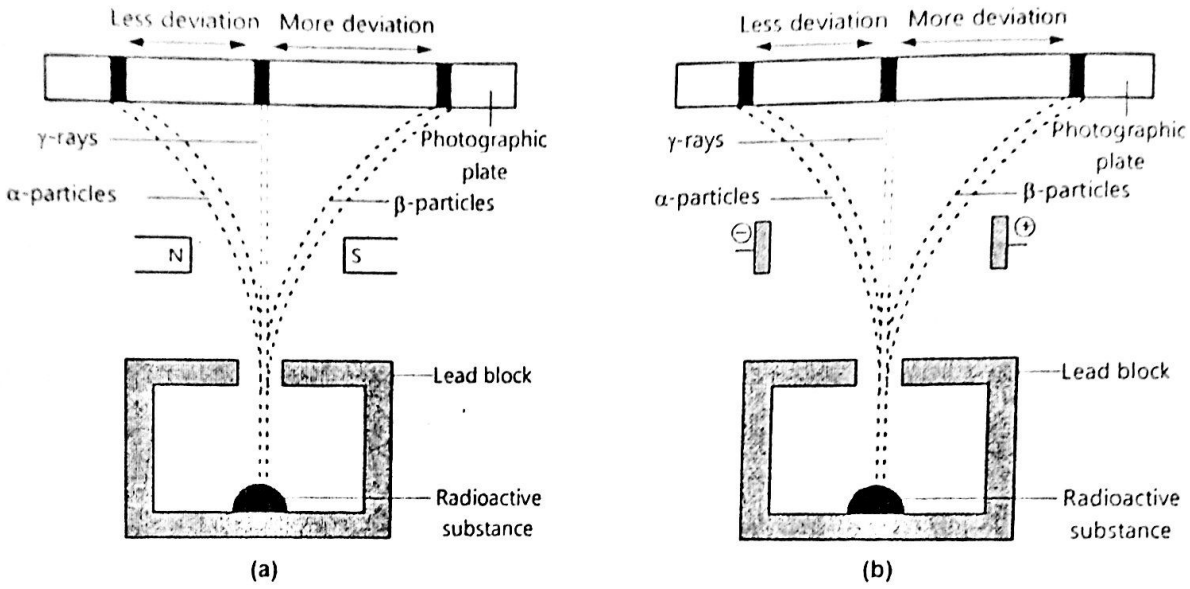
When the radioactive rays (obtained from radioactive substances) are passed through the magnetic field or static electric field, These are divied into three parts.

(a) α -rays consist of a stream of particles that are repelled by a positively charged electrode and are attracted by a negatively charged electrode and have a mass to charge ratio dentifying them as helium nuclei, ${}^{4}_{2}He^{2+}$. This indicates that a-rays have positive charge.

(b) β -rays consist of a stream of particles that are attracted to a positive electrode and are repelled by negative electrode and have a mass to charge ratio identifying them as β-particles, ${}^{0}_{-1}e$ or β^{-}. This indicates that β -rays have negative charge.

(c) γ -rays are unaffected by electric field. These has no charge and no mas and are simply electromagnetic radiations of very high energy.

β-rays are more deviated than the α-rays because e/m of β-rays is very high



Property	α-rays	β-rays	γ-rays
1. Nature	These carry positive charge. Each α-particle carries two unit positive charge and four units mass, i.e., they are simply helium nuclei.	They carry negative charge. Each β-particles carries same charge and mass as that of an electron. Hence β-particles are same as electrons.	They carry no charge and have no mass. So they can not be considered as made up of particles. They are simply electromagnetic radiations like x-rays.
2. Velocity	Their velocity is $\frac{1}{10}$ the of velocity of light, i.e., their velocity is 3×10^9 cm/second.	Theie velocity is 2.79×10^{10} cm/second.	Their velocity is same as that of velocity of light.
3. Penetrating Power	Being heavy particles, their penetrating power is smaller than β- and γ-rays. These penetrate the Al foil of the thickness of 0.002 cm.	Because of smaller mass and higher velocity, their penetrating power is nearly 100 times more than that of α-rays. These penetrate the Al foil of thickness of 0.2 cm.	Their penetrating power is even 100 times higher thanβ--rays.These penetrate Al foil of thickness of 100 cm.
4. Ionizing Power	Being heavy particles, they have high momentum and kinetic energy and hence high ionizing power.	Being much lighter particles than α-particles. They possess low momentum and kinetic energy and hence their ionizing power is $\frac{1}{100}$ th of the α-particles.	Because of no mass, their ionizing power is very poor.
5. Effect of Magnetic Field	These are deflected towards negative place.	These are defected towards positive plate. β-rays are deflected to a much than α-rays because β- particles are much lighter than α-particles.	Being neutral, these are not affected by electric field.
6. Effect on photographic plate	Black end the photographic plate.	Blackened the photographic plate.	Black end the photographic plate.
7. Effect on ZnS Screen	Produce fluorescence on ZnS screen.	Produces fluorescence on ZnS screen.	Produces fluorescence on ZnS screen.

Origin of α-, β- and γ-rays

α-, β- and γ-rays are producted by nuclear decay.

(1) Emission of α-rays: When an α-particle emits from the nucleus, atomic number and mass number of an element decreases by 2 and 4 units respectively.

$$^{213}_{83}Bi \longrightarrow ^{209}_{81}Tl + \underbrace{^{4}_{2}He}_{\alpha-particle}$$

An α -particle is composed of two protons and two neutrons.

$$2{}_1^1p + 2{}_0^1n \longrightarrow {}_2^4He$$

Thus atomic number and mass number of an element decreases by 2 and 4 units respectively of an element.

(2) Emission of β -rays: β -particles are nuclear electrons. When a β -particles emits from the nucleus, mass number of an element does not change but the atomic number is increased by one unit.

$$^{213}_{83}Bi \longrightarrow {}^{213}_{84}Po + \underset{\beta\text{-particle}}{{}^{0}_{-1}e}$$

It is considered that, when one neutron decays, one electron (β -particle), one proton and antinutrino is produced.

$$\underset{\text{Neutron}}{{}^{1}_{0}n} \longrightarrow \underset{\text{Proton}}{{}^{1}_{1}p} + \underset{\beta\text{-particle}}{{}^{0}_{-1}n} + \underset{\text{Antinutrino}}{\bar{\nu}}$$

Thus due to emission of β -particle, atomic number of an element increases by one unit but mass number remains as such.

(3) Emission of γ -rays: γ -rays are electromagnetic radiations like x-rays. γ -rays are produced from nucleus during nucleus decay. After emission of α - or β -particles, the element is in excited state. The element in the excited state emits γ -radiations and comes to the ground state. There is no effect of γ -emission on atomic number and mass number of an element.